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Fault-patch stress-transfer efficiency in presence of sub-patch geometric complexity

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It is well known that faults are not planar surfaces. Instead they exhibit self-similar or self-affine properties that span a wide range of spatial (sub-micrometer to tens-of-kilometer). This geometric fault roughness has a distinct impact on amount and distribution of stresses/strains induced in the medium and on other portions of the fault. However, when numerically simulated (for example in multi-cycle EQ rupture simulations or Coulomb failure stress calculations) this roughness is largely ignored: individual fault patches –the incremental elements that build the fault surface in the respective computer models– are planar and fault roughness at this and lower spatial scales is not considered. As a result, the fault-patch stress-transfer efficiency may be systematically too large in those numerical simulations with respect to the "actual" efficiency level.

Here, we investigate the effect of sub-patch geometric complexity on fault-patch stress-transfer efficiency. For that, we sub-divide a fault patch (e.g., 1x1km) into a large number of sub-patches (e.g., 20x20m) and determine amount of induced stresses at selected positions around that patch for different levels and realizations of fault roughness. For each fault roughness level, we compute mean and standard deviation of the induced stresses, enabling us to compute the coefficient of variation. We normalize those values with stresses from the corresponding single (planar) fault patch, providing scaling factors and their variability for stress transfer efficiency. Given a certain fault roughness that is assumed for a fault, this work provides the means to implement the sub-patch fault roughness into investigations based on fault-patch interaction schemes.